Keynote address ~~Proceedings of~~ at Seminar on Crop Protection for resource-Poor farmers, Sussex, Nov 91

KEYNOTE ADDRESS

Scientist or resource-poor farmer - whose knowledge counts?

ROBERT CHAMBERS

Institute of Development Studies, University of Sussex, Brighton BN1 9RE, UK

Hindsight shows that we scientists have often been wrong concerning tropical agriculture, and it is important that we recognize our limitations - we may have more knowledge about microscopic matters, but local farmers probably know more where continued observation and knowledge of inter-relationships are involved. Green revolution agriculture has been effective mostly in flat, irrigated lands where farmers can control the environment. In contrast, most rainfed tropical agriculture occurs in complex, diverse and risk-prone environments. Research stations even in such areas tend to be resource-rich, and have led to only incremental gains for resource-poor farmers. Farmers develop diverse cropping systems in response to an uncertain environment, and our discipline-oriented training neglects their complex linkages. Our role should be to provide farmers with information, allowing them to make the decisions and analyses, and accepting that they are fully capable. However, as well as recognising that it is the farmer's knowledge which counts, and the farmer who chooses, we must also ask, who gains, and especially, which farmer?

CONTEXT

We are lucky to be living in a period of rapid professional change. In IPM, as in other domains, there have been rapid developments over the past two decades both in our understanding and in the tools we have available for interventions and management. Other changes have been taking place in all the major professions concerned with rural development. This is exciting, even exhilarating. But for all of us, there is also a sense in which we are unfortunate, because so often the professional training we have received proves a handicap. Not only understanding, but also methods and roles have changed, and scientists are now called upon to do things they were not originally trained to do. The challenge, and the opportunity, is not just professional; it is also personal - to unlearn old things, to learn new ones, and continuously to adapt to change.

I shall first talk about ignorance and knowledge; then about past failures; and then suggest some potential solutions. Finally, I shall pose three questions.

IGNORANCE AND KNOWLEDGE

It is striking, and humbling, in both the social sciences and the more technical fields, how often in the past we have been wrong while so sure we were right. The history of development is littered with examples. In agriculture, one is the widespread belief, still repeated, that post-harvest losses of grain at the village level are of the order of 30%; but again and again when careful research has been conducted, the losses have been found to be only of the order of 4-8%. Another, told to me by David Lyon (NRI), is of 10 years' research in northern Nigeria based on planting cotton at the time optimal for yields - the start of the rains; but farmers declined to plant their cotton then, giving priority to their food crops, and planted their cotton only later. The lesson, painful to learn, was that since farmers were always going to plant their cotton late, it made no sense to do research to maximize yields at the optimum time from an agronomic point of view. Yet another example has been our ignorance, which looks surprising with the knowledge we have now, in advocating heavy pesticide applications.

Since we have so often been wrong in the past, we are probably still wrong on many counts. Recognising our errors is fundamental to the learning process. And we can expect that some of today's conventional wisdom will, in 5 or 10 years time, also prove to have been wrong. The lesson is that we must continuously question our beliefs and practices, and always be ready to adapt and alter them as we learn more. There is no permanent, normal professionalism which we can adopt for life, and especially not with complex interactive management systems like IPM.

Recognition of our errors and limitations raises the question of the comparative advantages of our knowledge and farmers' knowledge. This is illustrated in Fig 1. The researcher's and the farmer's knowledge can be shown in a simple matrix (Fig 1a). If we, as scientists, look at ourselves, we will admit that the most acceptable position for us - the best for our egos and self esteem - is box 1 - we know, and farmers do not know. Where farmers and scientists both know, and where they both do not know, we are on more or less equal footing (although quite often we pretend we know when we do not know). The least acceptable to us has been box 4, where the farmers know and we do not know. And yet that is often the most fascinating.

It is useful to consider our ideas of the relative sizes and content of these boxes, including with pests and diseases, and with their management. I would suggest that in the past we thought the boxes were as shown in Fig. 1b: there was a lot that scientists knew and farmers did not, and there was a bit that both knew, but there was not much that farmers knew which we did not. With growing wisdom, particularly through work with resource-poor farmers over the past 10 years, the size of these boxes in our professional consciousness has become more like Fig. 1c. Of course, the relative sizes vary by context, by subject, and in other ways, but we recognise now that farmers' knowledge is substantial.

It is revealing to fill in the four boxes and see what goes where. Scientists have an advantage with things which are microscopic, including tiny pests, bacteria and viruses. Farmers, though, have an advantage with what can be seen with the naked eye, where continuous field observation matters, and concerning the intricate relationships of their farming systems. Their knowledge is particularly important with IPM because their observations link with community participation and collaboration. Farmers are not ignorant and stupid, as some have believed in the past; they know more than we used to realise. But nor are they always knowledgeable and right about everything. As Bentley & Andrews (1991) have observed:

"Anthropologists and sensitized agricultural scientists need to avoid romanticizing or sentimentalizing traditional farmers at the same time as they take their knowledge and opinions seriously."

EXPLAINING PAST FAILURES

Let us now consider our rather dismal record in the agricultural and social sciences in serving resource-poor farmers. It is commonly said, in India, that only about 20% of all the technology generated in agricultural research is ever adopted by farmers. (There are some who consider 20% far too optimistically high.) Whatever the figure, all agree that there is a huge wastage. What is wrong, and what could be done to improve performance? One approach is to reflect on different types of agriculture in the world. The Brundtland Commission - the World Commission on Environment and Development - categorized types of agriculture into three broad classes: industrial agriculture consisting of large fields under monoculture, and plantations; green revolution agriculture, which was mainly irrigated on flat plains, much of this being in Asia; and a third, complex, diverse and risk-prone (CDR) agriculture, as practised by most resource-poor farmers in the world (Fig. 2). In industrial and green revolution agriculture, production has in the past been increased through simplification and standardization. This can be called a "Model T" approach to agriculture, after the remark attributed to Henry Ford concerning his famous first mass-produced popular car: "The American public can have their Model T any colour they like as long as it's black". This has been the tendency with both industrial and green revolution agriculture: to standardize and simplify in a package, always the same variety and the same advice. In this approach, the environment is controlled, E is made to fit G, the environment to fit the genotype.

These conditions contrast with the complex, diverse and risk-prone (CDR) agriculture of most of the rainfed tropics, where there are hills, swamps, undulating land, drought, risk of flooding, and other hazards. This includes much of sub-Saharan Africa. World-wide, this CDR agriculture, directly and indirectly, probably supports about 1.4 billion people. In conditions where population pressure is heavy on the land, farmers in CDR agriculture often complicate and diversify their farming systems in order to raise production and reduce risk. Their consequent need for variety has not been met by standardized packages. For them, E cannot be controlled to fit G. Instead, they require a range of G - a basket of diverse choices, instead of a standardized package of practices - to enhance their ability to adapt to and exploit a varied and unpredictable E. This need has often not been reflected in the practice and outputs of agricultural science.

The next question is what technologies does agricultural science generate for these conditions? The normal way in which agricultural science has been conducted is to generate technology on research stations and in laboratories, and then transfer it to farmers and their fields. This transfer-of-technology (TOT) mode is deeply embedded in our training and thinking. Most extensionists have been imbued with the idea that their role is to transfer technology.

The validity of this approach for CDR agriculture can be questioned. Figure 3 presents contrasts between physical conditions on research experiment stations and resource-rich farms on the one hand, and resource-poor farms on the other. Figure 4 similarly contrasts social and economic conditions. If most of these contrasts are true most of the time (they are not all true all the time), then it is not surprising that technology generated by scientists on research stations, in resource-rich and controlled conditions, with unlimited inputs and different priorities, is not acceptable much of the time to resource-poor farmers, whose conditions differ so sharply. The TOT approach and its methods have worked up to a point in the past with industrial and green revolution agriculture, because farmers' conditions were like those of the research station, or could be made like them. The same approach does not work with the resource-poor. For rainfed farming, the work of national agricultural systems, and of centres of the Consultative Group on International Agricultural Research (CGIAR) like the International Centre for Research in the Semi-Arid Tropics (ICRISAT), has led to incremental gains, but no green revolution. That this should be so is scarcely surprising when one looks at these contrasts.

THE RESOURCE-POOR FARMER'S POINT OF VIEW

Some sense of the uncertainty facing rainfed farmers, and their difficulty in predicting conditions, is given by Fig. 5, which presents the monthly rainfall figures for a rainfall station in India over 5 years. For any month, one can look back on recent experience, and ask what a farmer could reasonably expect in the coming month, and what decisions would be taken about planting, pest management, and so on. On the basis of the experience by the end of 1986, could better decisions be taken for 1987? Decision-making is very difficult for farmers faced with such uncertainty.

One response is to diversify. We are all familiar with the way in which farmers complicate their farming systems, adding to internal linkages. Aquaculture is a common case, often introducing several new internal linkages in a farming system. Another case is home gardens, or intensive small-scale farming. Figure 6 presents an example, a half-acre farm, on which six people live, in Kakamega District in Kenya. Gordon Conway, who sketched this in 1988, found about 60 species of useful plants were being grown. Such diversity is habitually underperceived by outsiders. A rule of thumb, on visiting a home garden, is to ask colleagues to guess how many useful species of plants will be found, and then multiply by 2 for an approximation of the actual number.

How do we as professionals perceive farming systems? One way of looking at knowledge is in terms of disciplines, departments and professional gaps (Fig. 7). As scientists, we are trained in colleges and universities in our disciplines, and these teach us to look at the aspect of farming systems on which we specialize. We then graduate and pass into a government department which reflects that discipline. On visiting a farm, our focus of attention, the first thing we look at, is what concerns our particular discipline or department. But are there things that all our disciplines and departments habitually miss?

There are many linkages that matter in farming systems, particularly in the complex farming systems that resource-poor farmers often want, but which our disciplines neglect. There is no line in Fig. 7 between crops and soils, because that link is well understood and has been well researched; nor does it show the household or people, who are so central to farming systems. Instead, it shows connections often overlooked or neglected by professional outsiders. For instance, the link between crops and livestock is often described in terms of "left-overs", as crop residues; but in many farming systems, the stover, used as fodder, is a vital part of the crop and of the farming system. The same applies to other connections shown in Fig. 7. And who is the expert on these internal linkages in the farming system? The answer is too obvious to state.

This raises the central question - whose knowledge counts? - a question to confront again and again. Also, whose analyses and whose priorities count? We tend to be reductionists. We like to have one criterion, such as production, or yield, but farmers as managers of complex, risk-prone systems have many criteria which they weigh up in the choice of crop varieties or the choice of pest management activities. Many examples could be given. When farmers in Colombia were asked to rank just for grain quality (Fig. 8), the first three were the same first three chosen by scientists, but then there were sharp differences between farmers and scientists. Again, Fig. 9 shows that for cassava varieties in Colombia, the yield rank and the farmers' preference rank diverged markedly. In the ICRISAT video *Participatory Research with Women Farmers*, the women had some ten different criteria for assessing pigeon pea varieties. Again and again farmers have shown that they have not single, but numerous criteria, for comparing and assessing varieties of the same crop. So, whose preferences or priorities count? Those of the scientist, or those of the farmer?

Answers to these questions give further clues to reasons for non-adoption by farmers of scientists' recommendations. Historically, different reasons for non-adoption have been offered at different times (Fig. 10). The explanation of non-adoption given in the 1950s and 1960s was that farmers were ignorant. Extensionists, teachers and social scientists assumed that the technology was good. The main social science research questions were - who adopts, and who does not? Why are some people early adopters and some laggards? I, among others, have sinned in doing research in this (unproductive) mode.

Then, in the 1970s and 1980s, people began to recognise more that there were farm-level constraints. The solution was to identify and remove the constraints, to try to make the farm like the research station, to make E fit G, the green revolution approach. This led to much social science research including constraints analysis, pioneered and propagated by the International Rice Research Institute (IRRI). This aimed to identify why farmers were getting lower yields that the research station, and how important different factors were in explaining the shortfall. If E can be controlled, and production is the primary aim, this can make some sense. But if E cannot be controlled, and a risk-minimizing multiple component livelihood is the aim, it is less useful.

In the meantime, farming systems research made a major contribution to understanding the complexity, diversity and riskiness of many farming systems, and how these explained non-adoption. But farming systems research sometimes became ponderous, and lost some donor support, notably from USAID. In approach and methods, we are now moving beyond farming systems approach to ask: who collects and analyses data, the scientist or the farmer? In the 1990s we are now aware that it is not the farmer, or farm-level constraints, which may be at fault, but the processes which generate the technology. If farmers do not adopt, it may be because they are intelligent and sensible, not because they are stupid and ignorant. We have then to change the process that generates the technology. This is true of the social technology of IPM as well as of other technologies. The key activity becomes not input supply, but farmer participation, and the real methodological frontier is how to enable farmers to do their analysis better; how to help them take command; and how to increase their confidence so that they can better adapt to changing circumstances. This approach fits well with the IPM focus.

These points are underlined, from another context, by Fig. 11. In their book *In Pursuit of Excellence - Lessons of America's Best-Run Companies*, Peters & Waterman (1982) present this table of reasons for the non-adoption of chemical and instrument innovations in the USA. Do the same criticisms apply in agriculture?

If this analysis is more or less correct, we researchers are part of the problem: the way we have been trained; the way we are organized in bureaucracies; the way we behave. Our superior behaviour and attitudes are an impediment it is convenient to overlook. We have not been concerned much with how we behave in the field and with farmers. But by acting in a superior manner, we deter farmers from showing what they know. If it is true that the comparative advantage of farmers' knowledge is greater than once supposed, what should we do about it? Do we need to change our behaviour if we are to enable farmers to use that knowledge and do more of the analysis themselves?

The book *Farmer First: Farmer Innovation and Agricultural Research* (Chambers *et al.*, 1989) presents evidence and argument which support the idea that farmers' participation in the research process can be crucial, and that there are really two complementary approaches. TOT is one, where scientists generate the technology and it is transferred to the farmer; and the other is farmer-first, which requires many changes in the way we operate. TOT and farmer-first are not alternatives; it will always be necessary to have research stations and laboratories. But we have given these too much weight and spent too much time in them, and given too little weight to farmers' knowledge and their capacity for analysis. The objective of a farmer-first approach is to empower farmers to be able to handle their environment and gain their livelihoods better than previously. For this, as perhaps in much IPM, it is not fixed packages, but principles for flexible application that we need to pass on, so that farmers can apply them through their own analysis and decision-making.

A classic example of the transfer of a principle comes from potato losses through sprouting in storage. In Peru, researchers had been working for 20-25 years on technology for reducing losses of potatoes in storage, but with virtually no adoption by farmers. Then anthropologists from the International Potato Centre (Centro Internacional de la Papa; CIP) spent time with farmers, and discovered that they did not necessarily see damage in storage as losses - some potatoes rot but are useful for feeding to pigs, and some shrivel but are a tasty delicacy. The anthropologists found that the farmers did have a problem, but it was different: that the newer potato varieties tend to sprout in storage. So scientists at CIP passed on the principle that diffused light in storage inhibits sprouting. Farmers took this principle, and applied it in innumerable different ways, very rapidly, in over 20 countries. It turned out later that the scientists had learnt this principle from farmers in Kenya: it was the farmers who had discovered it. But the main point is that it is often principles that need to be shared, rather than precepts.

POTENTIAL SOLUTIONS

The two families of approaches, TOT and farmer-first, are summarized in Fig. 12. For IPM, it is a matter to consider whether farmers want and need *principles* or *precepts*, *messages* or *methods*, *packages* of practices, or *baskets* of choices. The approaches are further elaborated in the context of seed breeding and multiplication in Fig. 13.

For farmer-first, substantial changes of role are implied on our part, as illustrated in Fig. 14. The roles for outsiders are different from those in TOT. Outsiders become conveners, catalysts and consultants; we search for and supply what farmers require; we may even become travel agents and tour operators to enable farmers to go and learn from others. If IPM is working well in one area, farmers from other areas can go and learn from them - usually a more effective means of learning than if we outsiders try to start something from scratch.

We have a deeply rooted but often false idea that farmers cannot undertake the sort of analysis we know how to do. To refute this, many examples could be cited. Let a few suffice.

It has recently been found that farmers can make complex causal and flow diagrams. Some examples can be seen in the video *Pictorial Modelling: a Farmer-Participatory Method for Modelling Bioresource Flows in Farming Systems* produced by the International Center for Living Aquatic Resources Management (ICLARM), of Malawian farmers drawing diagrams on the ground of nutrient flows on their farms.

Another example is shown in Fig. 15, the analysis presented by an old man in a risk-prone farming area in the semi-arid tropics in India. We asked him about changes in agriculture since India's independence in

1947, and he started to draw on the ground what had been happening to farming in that area, including declining soil fertility and increasing incidence of pests.

In Gujurat, in India, a farmer, the secretary of a co-operative, was asked about the impact of irrigation in his village. Normally, with a question like that, we would draw up a list, prepare a questionnaire, and interview people using our questions. But who are the experts on the impact of irrigation? Fig. 16 shows the diagram the farmer drew in about 20-25 minutes, with some assistance from his colleagues. It shows water flows, complex interactions in the fields, outputs, including food and money, the impact on different trees, and a positive impact on the school (which is something we might not have thought to ask about).

Interestingly, the ability to diagram like this appears to be independent of literacy. Indeed, farmers' diagrams of their farming systems can be more detailed and informative than those made by scientists.

Much the same has been shown with estimating and ranking. Figure 17 shows the matrix devised by an Indian farmer to distinguish the characteristics of six varieties of millet. Figure 18 shows one of a group of women near Marangu in Tanzania undertaking matrix scoring for six varieties of banana. First, they named 14 varieties which they grew, and then selected the six most important. They then named seven ways in which these varieties were prepared and consumed, such as frying, and *pombe* (beer). Then they used maize seeds to score the varieties for each of the seven uses. Later, when men and women were asked to rank the varieties, there was one difference (usually there are several): the men gave the main variety for *pombe* a higher rating. The lesson here is to disaggregate between groups of people - between resource-rich and resource-poor, between women and men, in making rankings and estimates.

Visual diagraming by farmers like these provides a means to express and enhance their own analysis, and also present an agenda for discussion. It can be vital for farmers to have time to discuss questions on their own, without outsiders present. Farmers, like others, enjoy and need iterative discussions, without being rushed, while our tendency has been to hurry and hustle. Not just for their learning, but especially for ours, diagrams made by farmers are useful. They can be "interviewed". Important questions may be identified through the act of diagraming. Multiple criteria can be weighed. In the ICRISAT video, for example, after the use of a matrix on the ground to compare varieties of pigeon pea, one ICRISAT and one Government release were rejected by the women, even though they were more pest-resistant than some others, because the balance of other criteria was more important. As with seed breeding, so with IPM, there may be many applications of new approaches and methods such as these.

QUESTIONS

Finally, in the light of all this, there are three questions for this conference.

The first is: *whose knowledge counts*? (Fig. 1). Does the scientist's knowledge count too much? Are we too dominant? Does the farmer's knowledge often not count enough? What are the comparative advantages of their knowledge and experience, and of ours? Where do we know better, and where do they know better? How can the two sets of knowledge be best combined? In any process of analysis, is the farmer's knowledge enhanced? Does she or he take command?

The second is: *who chooses?* Do we choose packages for farmers, or do we present them with baskets from which they can choose? There is a question of balance here. It may be that for IPM the word 'package' and what it represents makes some sense - but in general, is a package the right approach, or is a 'basket' better, where researchers suggest various things that farmers can do, and ask which they feel makes sense to them?

The third is: *who gains*? Of traders, resource-rich farmers, resource-poor farmers, consumers and scientists, who actually benefits? And especially *which farmers*, with questions of gender and poverty fundamental. Does the process in which we are involved with farmers lead them to gain in competence and adaptability?

The central issue we have to face is whether farmers are being empowered so that they can handle things better themselves, or whether it is scientists who are being empowered. The professional challenge to us is to stand down off our professional pedestals; to see whether through our efforts, it can be the farmers who are empowered; and to enable them to adapt and manage better in the uncertain and risk-prone environments in which so many of them have to struggle for their livelihoods.

REFERENCES

BENTLEY, J.W. & ANDREWS, K.L. (1991) Pests, Peasants and Publications: an Anthropological and Entomological View of an Integrated Pest Management Programme for Small Scale Honduran Farmers. *Human Organization* 50: 113-123.

CHAMBERS, R., PACEY, A. & THRUPP, L.A. (eds) (1989) *Farmer First: Farmer Innovation and Agricultural Research.* London: Intermediate Technology.

CIAT (1989) *Farmer Participation in Technology Design and Transfer*, Activity Report, 1988/89, Centro Internacional de Agricultura Tropical.

PETERS, T. & WATERMAN, R.H. Jr (1982) *In Search of Excellence: Lessons from America's Best-Run Companies.* New York: Harper & Row.

DISCUSSION

R. GIBSON (*Natural Resources Institute, Chatham, UK*). I am surprised and impressed if we manage a 20% take-up by farmers of our technologies, because I am fairly sure that if you take the research product of any research station in the UK or anywhere in the developed world, and consider the take-up by rich farmers with plentiful resources, 20% would be a very high take-up. If you consider the take-up of a commercial cultivar produced by a breeder, again even after a breeder has got it to the point where he takes it to the market place, I would be surprised if 20% of those are widely adopted.

N. JAGO (*Natural Resources Institute, Chatham, UK*). In Mali, the adoption of the iron plough and the charette, the donkey-drawn cart, has taken about 30 years, but now it is very extensive - the lesson from that is that naturally a resource-poor farmer won't try out new ideas unless he/she is shown over a period that they will work. These things will take time, therefore projects have to be sufficiently long to take that into account.